A.E.C. Production Control using IBM Computer

AEC SOUTHALL

SUMMARY OF ROUGH STOCK

PART NUMBER	COMBINATION	SPEC.
Y1 11903	Y0557	EN240
Y1 11904	Y0559	
Y1 11905	Y0572	EN111
Y1 11907	Y1853	
Y1 11910	Y1958	
Y1 11912	Y1962	
Y1 13904	Y1964	
Y1 14035	Y1967	
Y1 14067	Y1968	
Y1 14068	Y1988	
Y1 14071	Y1991	EN111
Y1 14073	Y1992	
Y1 14075	Y1993	EN110
Y1 14076	Y1996	
Y1 14077	Y1997	
Y1 14078	Y1998	
Y1 14080	Y4545	
Y1 14083	Y4546	
Y1 20606	Y4550	EN352
Y1 20607	Y4552	EN350
Y1 20612	Y4553	
Y1 20614	Y4557	
Y1 20616	Y4559	EN8
Y1 20617		
Y1 20618		
Y1 20620		
Y1 20621		
Y1 20622		
Y1 20623	Y5877	
Y1 20626	Y5878	
Y1 20627	Y6308	
Y1 20628	Y6309	
Y1 20629	Y6312	
Y1 20634	Y6313	
Y1 20635	Y7902	
Y1 20641	Y7903	
Y1 20645	Y7904	EN352
Y1 20646	Y8462	EN363
Y1 20649	Y8463	
Y1 20650	Y8464	
Y1 20658	Y8465	
Y1 20659	Y8475	
Y1 20661	Y8477	
Y1 20662	Y8480	
Y1 20669	Y8481	
Y1 20670	Y8482	
Y1 20677	Y8483	EN350
Y1 20680	Y8487	
Y1 20681	Y8490	
Y1 20685	Y8498	
Y1 24504	Y8614	
Y1 24505	Y8615	
Y1 24507	Y8616	
Y1 24508	Y9901	

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A.E.C. Production Control using IBM Computer

by W. J. Kease, Technical Assistant, A.E.C. Ltd.

O&M Case Study NO. 1

IN 1956 A. E. C. Limited, manufacturers of heavy vehicles, made history by becoming one of the first firms in the country to use an electronic computer. The circumstances which brought about this situation were varied but mainly concerned the improved efficiency of the production control department, which for over 20 years had been running entirely on a manual basis.

Before describing the O and M investigation that preceded the installation and use of the machine, and the improvements it is bringing about, it is necessary briefly to outline the company and its products.

A.E.C. is the principal manufacturing unit of the A.C.V. Group—the second largest builder of heavy vehicles in Britain. One of the problems it has to face is that nearly all its orders are to specific requirements so that continuous manufacturing principles cannot be adopted as they are in the motor car industry. Other problems are the wide range and increasing complexity of vehicles demanded by world competition.

It is therefore very important first, that component *varieties* be kept as low as possible, and second, that assembly problems be narrowed to within reasonable bounds.

The first factor is a requirement of company policy and a task for the designer. If units such as engines, gearboxes and axles are largely interchangeable, rough material can be bought cheaply, machine shops can manufacture economic quantities and the financial investment in material can be maintained at an optimum.

The need for the second requisite can be appreciated when it is realised that the time taken to assemble a four-wheeled vehicle and an eight-wheeled vehicle can differ by as much as 50 man-hours.

What Production Control Does

Whilst the task of the production control department in any organisation is obvious, each company has its special domestic situation, and the precise scope of the department varies from one organisation to another.

At A.E.C. production control is responsible for the inter-relation of all phases of production from the receipt of orders to the delivery of the finished product. It receives and analyses product information issued by the drawing offices; requisitions, schedules, receives, stores and issues all material; compiles machine tool loading figures and regulates and records the achievements of the factory.

There is close liaison between the production control department and the sales organisation which in A.C.V. is established as a separate company from the manufacturers.

The first move in the selling/manufacturing procedure of the group is the issuing by the sales company to the manufacturing company of a bulk

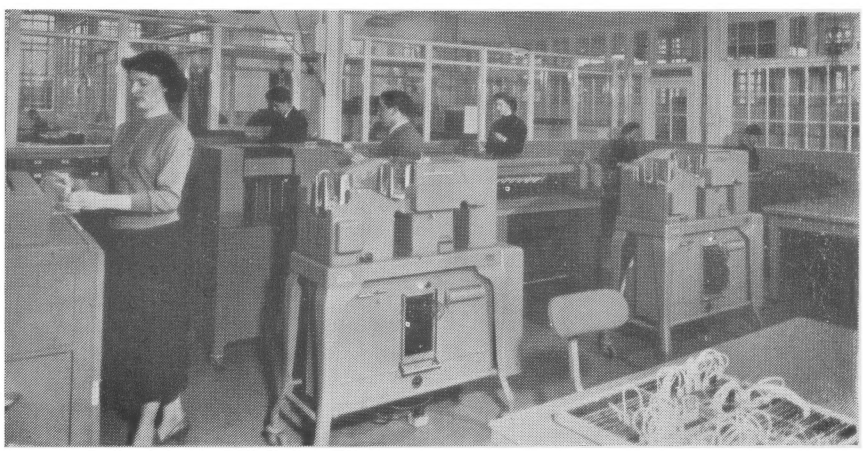

Fig. 1. This is a general view of the computer room showing, at left, a girl working a portion of the computer machine. In the foreground centre and right are two reproducing machines which reproduce information from punched cards to unpunched cards.

order. This covers specific quantities of basic vehicle types which are to be produced during a stated period, commencing not less than nine months from the date of the bulk order. The bulk order is, in effect, a long-range sales forecast.

Analysing The Vehicle Types

When production control receive the order, the vehicle types are analysed into part number form and the total quantity of each part needed is calculated. Then, taking into account any over-commitments for material made against existing bulk orders, requisitions are issued to the purchasing department who, in turn, place orders with suppliers.

Later, a production programme is issued (compiled jointly by the sales and manufacturing companies), listing in weekly form the order in which the vehicles covered by the bulk order are to be built.

The vehicles listed on the production programme represent definite orders, so it is now possible to calculate the rate at which the material is needed from the suppliers; it is also possible to take into account material for any special features which customers require to be incorporated.

A document called a traders' schedule is issued instructing suppliers when to deliver, and in what quantities. As the material arrives it is booked in and, after inspection etc., the outstanding balance is reduced.

This procedure may appear straightforward but it must be appreciated that it has to be carried out for every part number on vehicles contained in 24 main groups, comprising a possible (though not probable) 270 vehicle types and 30,000 different pieces. Account has to be taken of such things as a part-number being used in varying quantities on different models and the necessity, on occasion, to procure the same material from more than one supplier.

Every transaction (ranging from a simple " goods received " entry to a complex assessment of a traders' schedule) involves one or more calculations followed by a manual entry on records. The total amount of clerical work involved is obviously very substantial.

Compiling The Work Load

The work of compiling the machine-tool loading summary is comparable to the foregoing. It involves treating each factory-machined part number separately, assessing its total requirements in the form of different machining operations: milling, grinding, etc., in accordance with the production programme.

Account is taken of the economic machining-batch sizes and the batch throughput times, and a document known as the factory schedule is created showing the starting dates for each batch of each part number for the appropriate period ahead.

The plant capacity is obviously taken into account on the factory schedule, any possible overload being either sub-contracted or re-scheduled to an underloaded period.

A master record card is kept of all material

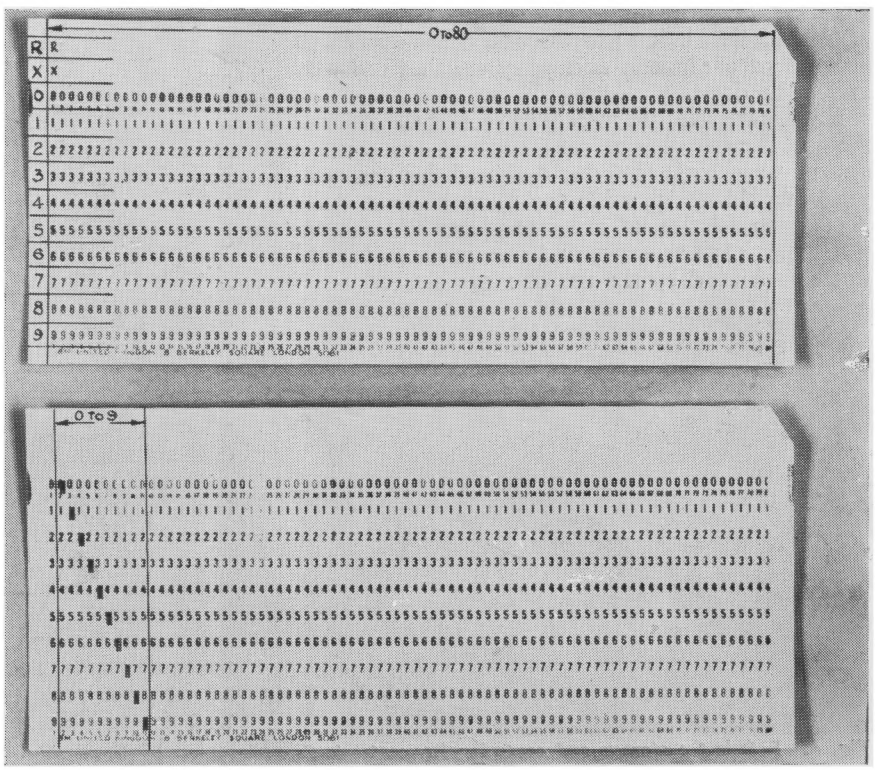

Fig. 2. At top is the unpunched card which has its depth divided into 12 and its width into 80 sections. When the card is punched, as in the lower card, the information denoted by the placing of the holes is " read " by the computer.

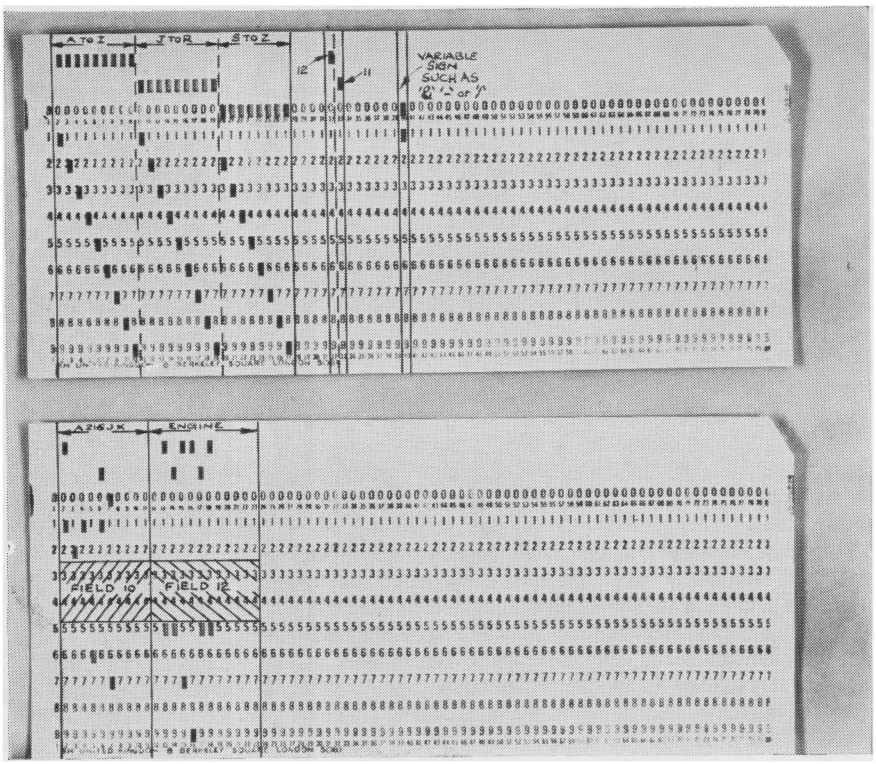

Fig. 3. How alphabetical characters are represented is shown by the upper card which also contains variable signs. The lower card shows specific information relating to an engine.

movements, goods received, rough stores issued, finished stores issued, goods despatched and so on, all of which involves large numbers of minor calculations in addition to the main ones outlined.

When the production control department was initially investigated it was found that its efficiency was limited by the inter-relation of separate pieces of information being processed and the enormous amount of arithmetic and petty calculations that had to be done.

It was realised that merely to extend the manual method in non-arithmetical directions—even if the system were extensively re-designed for the purpose—would not provide the answer because the rapid inter-relation of separate pieces of information essential to accuracy and greater control could not be achieved by the use of more clerks.

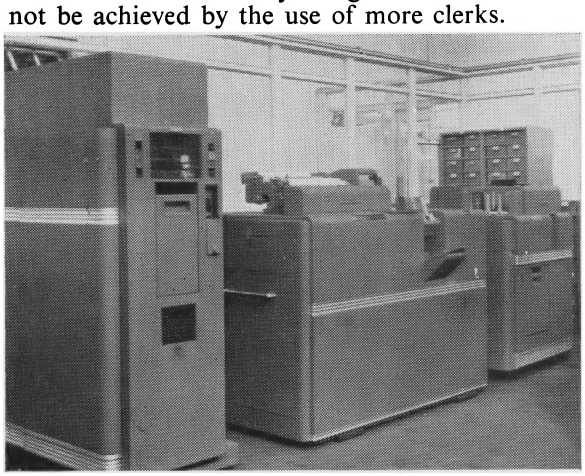

Fig. 4. Left is the storage and control unit; centre is the printer output; right the punched card input and output.

For the first time the possibilities of electronic data processing equipment were considered and information was drawn from all representative sources.

The Digital System

An electronic data processing system is built around a central computing machine and, since most business data processing is concerned with " numbers," or " digits," the machine is usually termed a " digital " computer. Such machines perform sequential mathematical or logical operations in accordance with a numerical scheme based on digits which progressively do not vary.

The medium on which digits are presented to the machine can assume many forms, but one of the most convenient and economic is the punched card. By means of a code of holes these cards allow a flexible method of recording information and permit relevant data to be initially processed, selected, and fed to the computing machine in an efficient manner.

Punched cards may also be used as move-tickets and other engineering shop documents, stock records, financial records and so on, permitting large-scale economies in stationery and time in translating from ordinary language into machine " language."

When the company decided that electronic data processing equipment with punched card actuation might be a practical proposition it was resolved that the machinery should:

1. be capable of dealing with a large volume input of alphabetical and numerical material;

2. be able to store data required during calculations and hold them for immediate access;
3. perform most normal arithmetical operations during the standard time of one card passage but, in the case of more elaborate calculations delay output until the work was completed;
4. accumulate the results of calculations until required;
5. have the facility of dual output, i.e., punched cards or printed tabulations, and be able to output at speed in both alphabetical and numerical symbols;
6. be capable of programming in a simple, effective manner;
7. be reliable, adaptable, and economic to purchase (or hire), and operate.

Consulting Computer Manufacturers

Preliminary consultations were held with the principal manufacturers of punched-card actuated electronic data processing equipment, and reports of appropriate installations in America were studied. In addition, a visit was made to a continental firm using data processing machines to control a batch production factory. Although this latter company manufactured sewing machines, the variety of their products and the number of pieces involved showed what could be achieved with the latest electronic office equipment.

After the preliminary work, a computer manufacturer was invited to make an exhaustive survey

Fig. 5. This card sorting machine collates the cards into a required order for processing by the computer.

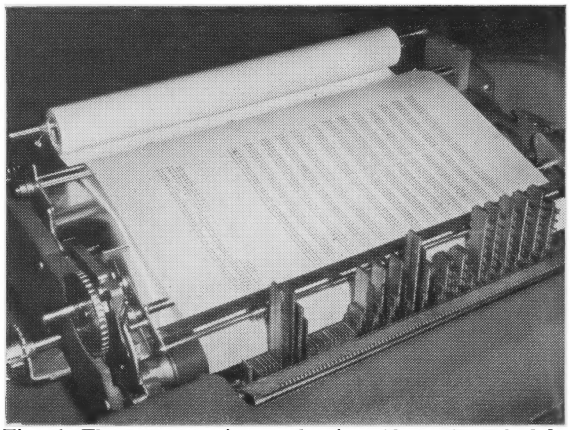

Fig. 6. The output printer, showing 13 weeks schedule being printed direct from computer calculations.

of the company's office needs. This survey established the variations of product and the piece part and material content of each; the material procurement and processing cycles; the stock control and plant loading measures dictated by the sales market and the factory capacity; the load and flow of documents at various stages; and full details of all factors bearing on the processing of data for control.

A comprehensive report with recommendations as to the machines required, was submitted to management and a series of round table conferences took place. After final deliberations at director level a contract was signed to hire a series of machines—centred around an electronic "hook-up"—which answered the seven above requirements. Hiring, instead of buying, had the advantage that new and improved machines could more readily be installed.

"Carding" The Information

The punched cards measure $7\frac{1}{4}$ ins. $\times$ $3\frac{3}{8}$ ins. and an unpunched general specimen is shown in the upper card in Fig. 2. In all cases the information carried on each card is in the form of rectangular punched holes in the body of the card which has its vertical dimension divided into twelve and designated from top to bottom: R.X.O. 1.2.3.4.5.6.7.8.9, and its horizontal into eighty columns (each capable of containing one digit) numbered from left to right, 1 to 80. The digits 0 to 9 inclusive are shown punched in columns 2 to 11 in the lower card in Fig. 2.

Alphabetical characters are represented by two punched holes in each column, A to I being denoted as R1 to R9, J to R as X1 to X9, and S to Z as O2 to O9.

This arrangement is shown punched in columns 2 to 27 inclusive in the upper card in Fig. 3. The combination 01 may be used to represent a sign such as "—," "/" or "&" and is shown in column 40; "R" can also mean 12, and "X" mean 11, as shown in columns 32 and 33.

Since cards are used as general purpose documents it is usual to have selected information, which is already punched into the card, printed in normal characters along the top edge. A card bearing the part number A216JX and the title " Engine " is shown in the lower card in Fig. 3. Each significant group of digits, such as a part number or a title, appears in a collection of columns known as a card " field,"; thus, in Fig. 3; A216JX appears in a part number field containing ten digits, and the word " engine " in a title field of twelve digits. Field lengths are completely flexible and are designed to suit each particular application.

The Libraries

Cards are contained in what have come to be termed " libraries," " status files " and " history files." Libraries contain fundamental information relating to the manufacture of the product, and may only be altered for two main reasons:

Change in product design.
Change in manufacturing method.

In the present case, three libraries were established:

1. Model library—containing details of all the units (axles, gearboxes, etc.) used on each model.
2. Unit library—containing details of all the piece-parts used in each model.
3. Piece-part library—containing details of material used to make, and all operations performed on, each piece-part.

Status files containing current positions of each item of stock were set up under the headings:

Rough stock file—giving " in stock " and " on order " quantities, " allocated " and " unallocated " stock data.

Finished stock file—giving " in stock " and " in process of manufacture " quantities with " allocated " and " unallocated " stock data.

Bought-out finished file—giving comparable information to that contained in the Rough stock file.

A further status file contains details of available plant capacity.

History files carry all retrospective information relating to transactions affecting the status files, and history files such as " goods received," " operation record," " material requisition," and " spare requirements " are being established.

To date, the stage of creating the finished stock status files has been reached, the basic libraries being complete. The brief outline of the data processing technique which follows, is not, therefore, fully backed by practical experience on this particular installation.

So far as is known, the installation will be the first of its kind in the country to be performing a full routine on production control procedure, and so will be of an experimental nature for a period.

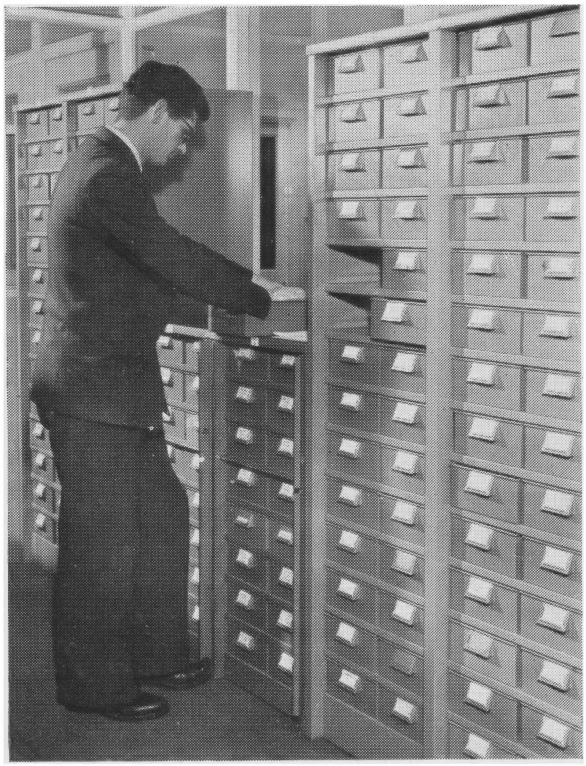

Fig. 7. The model and unit library. Each drawer contains some 2,300 cards.

It is, of course, backed by the experience of manufacturing concerns in other countries—continental Europe and, most notably, the United States, and obviously a working procedure has been devised.

The Processing Technique

The procedure begins with the analysis of a bulk order from the sales company. The relevant model cards are withdrawn from the library with all the appropriate unit cards behind them. They are put through the computing machine preceded by instruction cards stating " 20 sets of units for Model ' A ,' 30 sets for Model ' B,' 40 sets for Model ' C ' " and so on, according to the requirements of the bulk order.

The computer calculates the number of each unit required for each model, and punches cards (one for each unit) with this information. The unit cards are then sorted into alphabetical and numerical order.

This procedure is repeated with the piece part cards preceded by the unit cards, the computer calculating the total quantities required of each component, and punching blank cards with these data. The requirement cards are sorted into part number order.

The finished stock status cards are merged with the requirement cards and fed into the computing

machine, which deducts unallocated stock balances and produces a requirements card for each " finished " part.

The material cards from library are then merged in, so that rough material part numbers and sizes can be established. The rough stock cards are merged in, the machine deducting any unallocated stock balances. Through its output printing unit, it prints a list in part number order of material to be ordered, which is used by the purchasing department as authority to order material.

Calculating Materials Delivery

When the orders are placed, the purchasing department returns to the data processing section information on the names of suppliers and quantities placed on order and, after the punched card input carrying this information has been prepared, the computer calculates the rate at which the material is to be delivered (allowing due procurement and machining time) to meet the production programme.

A traders' delivery schedule is produced on the output unit of the computer and a copy of the schedule is sent to each supplier concerned.

A similar procedure to the foregoing applies to the carrying out of the planning function. The computer calculates the starting dates for each batch of work and, by totalling, calculates the overall machine load. Should a particular section of the factory be overloaded, the jobs suitable for sub-contracting are automatically selected—a check having been carried out to ensure that the jobs so effected could not be re-scheduled to an underloaded period.

Checking Goods Received

When the computer calculates the delivery dates for material it punches up goods-received cards which are set aside in a special file to be issued to the goods received department a week before the material is due in. Should the material, when delivered, vary from the pre-punched information the cards are easily adjusted.

In a similar manner when the computer calculates starting dates for batches of work, it prepunches material requisitions and job operation cards. These latter are intended to act as the core of progress effort.

Five days before jobs are due to be commenced a printed list is supplied to each section foreman concerned, together with all the necessary job operation cards bearing the starting and finishing day number. As jobs are completed the operation cards are returned to the data processing section and checked against the factory schedule, all jobs behind schedule being listed daily for manufacturing priority action.

There are, of course, many other jobs laid out for the computing machine in addition to the principal ones just outlined. There is maintenance of the stock status files, for example. Goods received cards are daily sorted into part number order and merged with current status cards. The computer then takes the new material into the stock record, adjusts the balance figures, and automatically produces new stock status cards.

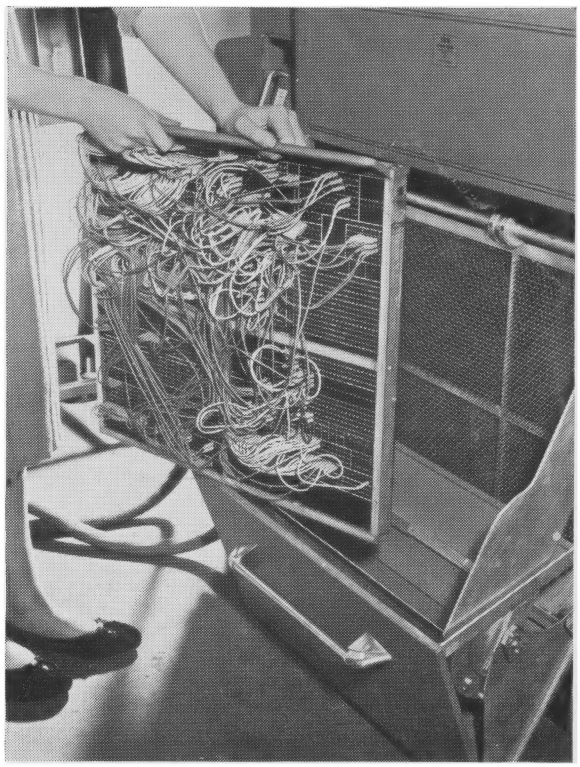

Fig. 8. A pre-plugged programme being inserted into a section of the computing machine.

The computer will also calculate quantities of parts to be issued against the vehicle erection programme, three weeks before erection is due to begin, and print a list of " shortages," if any, for progress action to be taken.

Redundant Staff?

These are but a few jobs destined for electronic data processing. To sum up: the whole routine procedure of the production control office, from receipt of bulk orders (long term sales forecasts) to delivery of finished vehicles, has been designed to be swift, accurate, and to high-light " action " points. It has been designed to be as automatic as possible, and to release the clerical staff in the production control department for ensuring that the factory throughput is smooth, and obviating endless quantities of petty arithmetic.

It follows, of course, that as the electronic data processing system is progressively installed some of the clerical staff will become " redundant," but natural wastage will cancel out a high percentage.

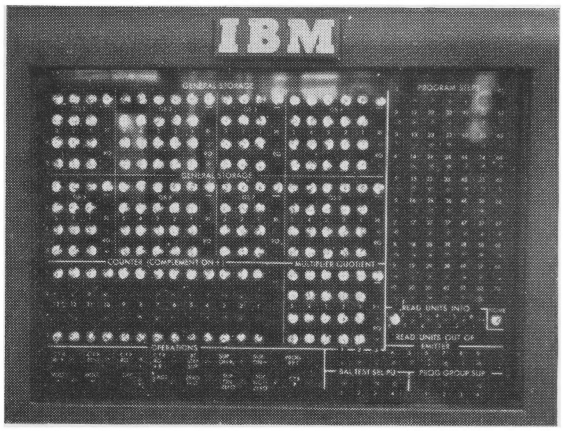

Fig. 9. The glass panel of the computer. Each illuminated neon tube shows that the machine's memory contains information.

As there will be openings in other sections of the manufacturing company for the remainder, redundancy is not a serious problem.

The electronic data processing section comprises thirteen machines, three of which, when linked together, form the computer, the other ten being ancillary service machines.

The computer is shown in Fig. 4. The main arithmetic, storage and control unit, the 604, is on the left; a punched card input, printed output, and subsidiary arithmetic unit, the 421, is shown in the centre; and a punched card input and output unit, the 521, is shown on the right. The 604 and 521 can also be linked together independently of the 421, which may be left free to operate as a normal accounting machine.

The Computer's Function

The computer functions as follows: information is read in from punched cards placed in the 421 and any factors for calculation, other than the additions and subtractions performed by an ordinary accounting machine, are communicated to the 604. The necessary "programme" of arithmetical and logical operations is there carried out, and the results are stored (in vacuum tube registers), printed by the 421, or punched into output cards by the 521.

Advantage may also be taken of the fact that results of complex calculations may be distributed to the counters in the 421 and retained there for subsequent summary punching.

The computer is able to perform seventy programme steps, all or selected parts of which may be repeated at will. Sequence control is by means of plug boards.

The calculating unit works to the base 10, with binary decimal coding. Its speed is $\frac{1}{2}$ millisecond for addition, 11 milliseconds for multiplication, 13 milliseconds for division and 48 milliseconds for transfer. The storage register may be broken up into various required capacities and the decimal point may vary in position.

The ten ancillary machines comprise two card punches, two card verifiers, two sorters, one collator, one interpreter and two reproducers.

The Ancillary Machines

A card punching machine is operated electrically from a keyboard similar to that of a typewriter, alphabetical or numerical information being punched by a single key depression. The machine can be set up for duplicating repetitive information at the rate of ten columns per second.

The verifying machine is similar to the punching machine but instead of punching it electrically senses, at each key depression, the information which should already be punched in the appropriate column. If an error is detected, i.e., if the information in the column being sensed is different from that transmitted by the key being depressed, the machine locks and the card has to be removed for re-punching.

A sorting machine is shown in Fig. 5. It allows punched cards to be repeatedly arranged and rearranged in different combinations, permitting a great many analyses and reports to be prepared from the one original recording in the cards. The machine incorporates an electronic amplifying unit and sorts at a rate of 39,000 card columns per hour.

The collating machine automatically performs such operations as: filing current cards with previous cards; replacing old cards with new cards superseding them; selecting all cards earlier than a certain date, as for analysis of jobs behind schedule; combining library cards with stock status or history cards; and separating them again after their use in computing machine operations.

The interpreting machine translates the holes punched in the cards by printing on the faces of the cards the alphabetical and numerical information which the holes represent. The machine speed is 3,600 cards per hour.

A reproducer will repetitively copy information from a master card into any number of detail cards, and into any required position on those cards. It will copy information contained in one pack of cards into another pack, both packs remaining separate and in order.

It is also fitted with what is termed a "mark-sensing" device. In certain applications, say in issue of material from a store, it may not be possible to use pre-punched cards; equally, to punch new cards from hand-written chits may be laborious. So special cards are used and quantities issued are marked in pencil on the faces of the cards. The reproducer transmits an electrical charge through the graphite on the marked surface and automatically punches the information into the cards at the rate of 6,000 cards per hour.

Planning the Change-over from the Manual System

ONE of the most important qualities needed in a data processing staff is " mental discipline." If this is absent training is wasted and serious errors of judgement can be made. With the right mental approach, however, the employee will leave nothing to chance; he will appreciate that he is dealing with machines which are essentially logical in operation and that any information presented to the machine must be in a precise and established form. Both operators and machines must combine to form a data processing unit.

A simple example of this discipline is shown by the punching and verifying operations. The verifying machine checks the accuracy of the cards which have been punched by the punching machine. Since the verifying machine operator works from information used by the punching operator, the chances of both operators making the same mistake is extremely small. However, in the early stages of using the system such errors were being made. It was found that when the verifying machine detected an incorrectly-punched card the operator withdrew the cards from the machine, looked at the information punched on it, then operated her machine accordingly. By not having the right mental approach this operator had doubted her own ability and preferred to believe that the punching machine operator had been correct.

These errors were soon discovered and the punching and verifying machines were " isolated " from each other and no two girls worked together as a team. In addition, every card issued has to be accounted for and all errors passed to the supervisor.

Most of the initial training on all the machines is done by the manufacturers of the equipment, IBM United Kingdom Ltd., as part of their service. Punch and verifier operators are selected by A.E.C. in accordance with a simple aptitude test and then trained on A.E.C. premises by an IBM instructor.

Training Methods

Their early training consists of learning the machine keyboard (similar to a typewriter), fingering, and how to get the best performance out of the machine. These operators are exclusively young girls of 16 to 20, drawn mainly from secondary modern schools. They translate routine documents into punched card form and, by a set method of testing, ensure that the machine produces cards which are suitable for subsequent processing.

The first check on these machines is to see that new and unpunched cards are correct in size and not distorted—an " off-centre " hole could lead to all sorts of complications in a final order. Each morning and afternoon punch operators punch a card containing all possible characters and digits and check it against a card gauge. At any sign of off-punching the " resident " IBM engineer is notified to correct the fault. A deliberate mistake is then made in punching a card to see if the verifying machine spots it. Again, discrepancies are notified to the IBM engineer for correction.

Training for the sorters, interpreters and reproducers is by IBM at a one week school. This includes basic instruction on the operation of the machines, examples of plug board programming, tests to see if the machines could misfunction, and standard routines to be performed at regular intervals. Tests for these machines consist, in the main, of putting test cards with all alphabetical characters and digits through the machines to ensure that all the holes are read correctly and at the proper speed.

Training on the collating machine consists of a week on the auxiliaries and a week on the collator. Testing of this machine is to pass a set of cards through the machine in such an order that every possible condition that can arise does so.

High Mathematical Standard

Computer programmers and operators complete a three weeks' course on the hook-up after a week on the auxiliaries and a week on the collator.

Fig. 10. Two punching and two verifying machines. The verifying machines (left) check the punched cards produced by the punching machines (right).

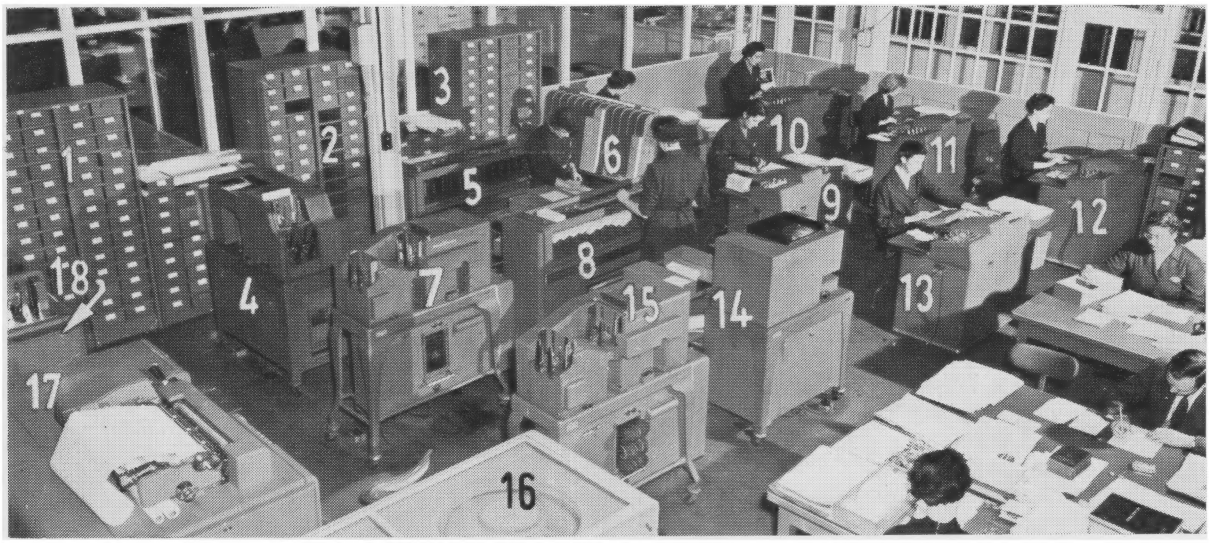

Fig. 11. The electronic data processing department of A.E.C. showing: 1-3, files and libraries; 4, collator; 5, sorter; 6, sorting rack; 7, reproducer; 8, sorter; 9, verifier; 10-12, punching machines; 13, verifier; 14, interpreter; 15, reproducer; 16, calculating and storage unit; 17, card reader and output printer; 18, punch card input and output machine.

Programmers are expected to have mathematical abilities up to higher school certificate or national certificate standards and, if possible, a bias towards electrical engineering, though this is not essential. Those who operate—as distinct from programme—the computer, need not have this mathematical ability to the same extent, but should have a higher level of mental discipline than the auxiliary machine operators and an aptitude for assimilating information.

Successful completion of these courses does not mean, however, that operators are wholly capable of undertaking full responsibility for machine operation. This only comes after some months of regular work on the company's products. At A.E.C. it was found that employees on the operational side with a knowledge of the company's products could be trained effectively, but that as a rule the analysis of the problem and programming it into the machine could be seen rather better by a person who did not have too detailed a knowledge of the company's products and had not become engrained with the way the manual system operated.

Union and Staff Concern

The proposal for the electronic data processing system was introduced to all staff levels by short round-the-table discussions. These concerned the work to be performed on the machines and the general manner of operation of the machines. Illustrated booklets, which graphically depicted various salient points, were supported by actual demonstrations on the machines.

The first group to be contacted was the staff representative committee. When they were assured that the scheme posed no serious redundancy problems, they received it enthusiastically and requested additional information.

The second group consisted of trade union representatives and members of the joint production advisory committee. The latter group then disseminated the information on the shop floor.

The third group were those employees concerned in the preparation of routine documents into punched cards. Any production control procedure is, because it involves people, dynamic and subject to continual change. Individuals tend to view their own section of the work in isolation and introduce minor changes for personal convenience. This has a grave effect on the efficiency of the system as a whole and so it was stressed to this group that all documents should be filled in in a precise manner, that only one transaction should be notified on one document, and that any apparent anomalies should be taken up with the supervisor. In this way considerable improvement was gained in production control records even before the computer was used.

Superseding The Manual System

This electronic data processing system is being introduced very slowly, and only when it functions perfectly does it supersede the manual system.

The first job done exclusively by the computer was the product analysis of the vehicle bulk order, as described earlier. The computer was given a trial period during which it worked in parallel with the manual system and took over permanently only when it proved it could do the job.

Stock recording of gearbox and clutch components was also tried out on the computer and run in parallel with the manual system. After a three months' trial it took over from the manual system and is now solely responsible for the job. Other sections of vehicles are now being duplicated for the run on the manual and electronic systems before they too are taken over by the computer.

Another task to which the computer has been put is machine tool loading. A small, self-

contained A.E.C. factory was chosen for the experiment and all the jobs' information was put on to punched cards. When an operation is finished the punched cards relating to the job are compared with the basic card to show what jobs are falling behind schedule.

This is the stage reached at the time of writing.

Future Work For The Computer

The next stage will be to compute machine tool requirements against a future programme. By the time this is done such anomalies and difficulties as have occurred in the workshops over the use of punched cards will have been eliminated.

Weekly Salaried Staff Pay Roll. From the beginning of the new tax year in April, the weekly salaried staff pay roll (approximately 1,350 employees) will be produced on the IBM machines. Other projects are, of course, being planned. It is too early to give any definite pointer to future development, but here are typical procedures being considered for investigation and implementation:

Labour Requirements and Loading. Since machine tool loading and factory capacity have already been planned, it can be assumed that considerable benefit would be achieved by undertaking the complementary work of labour-loading. When the production programme is analysed into constituent operations and manufacturing batches, the labour available can be scheduled to indicate what labour, of what specific types, is needed over the appropriate period ahead. This would necessitate setting up a complete personnel file in punched card form. Such a file would contain a short history of each employee and note any special attributes of an employee.

Producing Shop Documents

Production of Shop Routine Documents. The project for machine tool loading does not include routine production of such shop documents as manufacturing process lay-outs. In an organisation like A.E.C. these amount to many thousands in the course of a year's production. It will be remembered that the number of individual pieces in the range of vehicles is approximately 30,000. The average number of operations on these parts is around 10. Each manufacturing process lay-out contains information on manufacturing times, jigs, tools, fixtures needed for the processing of components on machine-tools, and detailed instructions as to what precise operations are to be performed.

Saving On Old Methods

These lay-outs are now produced by embossed plates, up to three plates being required for each lay-out operation. This information can be translated on to punched cards for production on the printing unit of the computing machine, and possibly considerable amounts of time and money could be saved between the embossed plate and the punched card methods.

Purchase Ledgers. It will be recalled that requisitions for material to be purchased will be produced on the computer, and it seems reasonable to suppose that this process could be extended to producing purchasing department routine documents on the computer. The purchase ledger may also be kept by electronic data processing methods.

Works Pay-roll. The job at present being considered is production of the works pay-roll. This will differ from the staff pay-roll because there are a number of additional features to take into account: various bonus rates on small-group and large-group bases, special allowances and lieu rates, overtime working to several scales, and numerous differential payments.

From the foregoing it will be seen that electronic data processing is still in its infancy. It is quite easy to imagine other processes which can be electronised but the important thing to bear in mind is that enthusiasm and foresight must at all times be tempered by the intention to get each section working thoroughly in the computer before a further section is attempted.

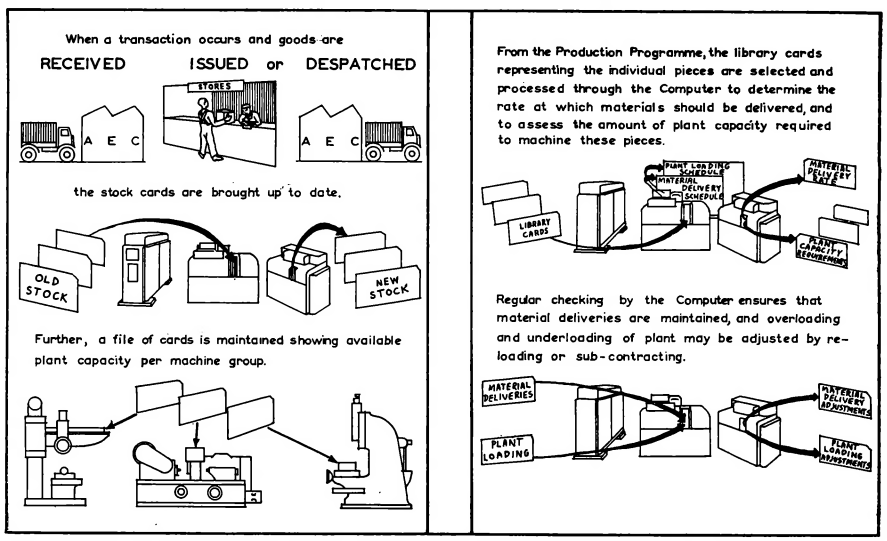

Fig. 12. Two random pages taken from a booklet produced by A.E.C. to show employees what the computer can do and how it does it.

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